MICROWAVE AND ION BEAM STUDIES OF AN APPLIED B_θ DIODE

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A parametric study of the microwave radiation emitted from an "Applied B_θ" magnetically insulated ion diode was undertaken using a microwave detection system which covered the frequency range from approximately 0.3 to 85 GHz. The amount of power measured implies that collective mechanisms are responsible for the generation. While no theoretical framework exists to explain the mechanism for the microwave flux, comparison with a simple two-dimensional model of the diode suggests that the variation of the peak microwave power as a function of the applied field ratio $B_\theta/B_\perp^*$ is connected in a general way with the extent to which the electron sheath covers the anode-cathode (A-K) gap.

A study of the quality of the ion beam generated by the B_θ Diode indicates the existence of a disruptive mechanism of length scale 0.5 cm in the A-K gap. The effects of the mechanism are most readily observed when the applied field is adjusted so as to produce the largest amount of microwave radiation. A deformation of the anode plasma appears to be the most likely cause of the beam disruption. Perturbations of the electron flow are discounted as a cause for the effects seen, because at high frequency the field strengths required are too large to be realistically possible, and at low frequency (i.e. for time scales on the order of tens of nanose-

conds) such a perturbed flow would have to remain stationary for times well beyond the 1 nsec crossing time of an individual electron. The results indicate that the smoothest ion beam formation occurs at high B_o/B^* values, at the cost of some loss of ion beam efficiency. However, the loss is not as severe as that predicted by (one-dimensional) theory.

Left unresolved is the connection (if any) between the presumed anode plasma deformation and the microwave radiation. A theory or particle simulation of the B_θ Diode is needed to explain not only the mechanism of the microwave generation, but also to explain, for instance, why the anode plasma of a Teflon anode displays greater evidence of deformation than the plasma of a Lucite anode. Suggested improvements in the experimental apparatus are an upgraded low frequency detection system that may yield enlightening information at frequencies as low as 20 MHz, and an improved magnetically insulated Faraday cup to further diagnose the multi-kA carbon beam generated by the Teflon anode.